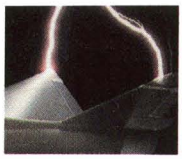
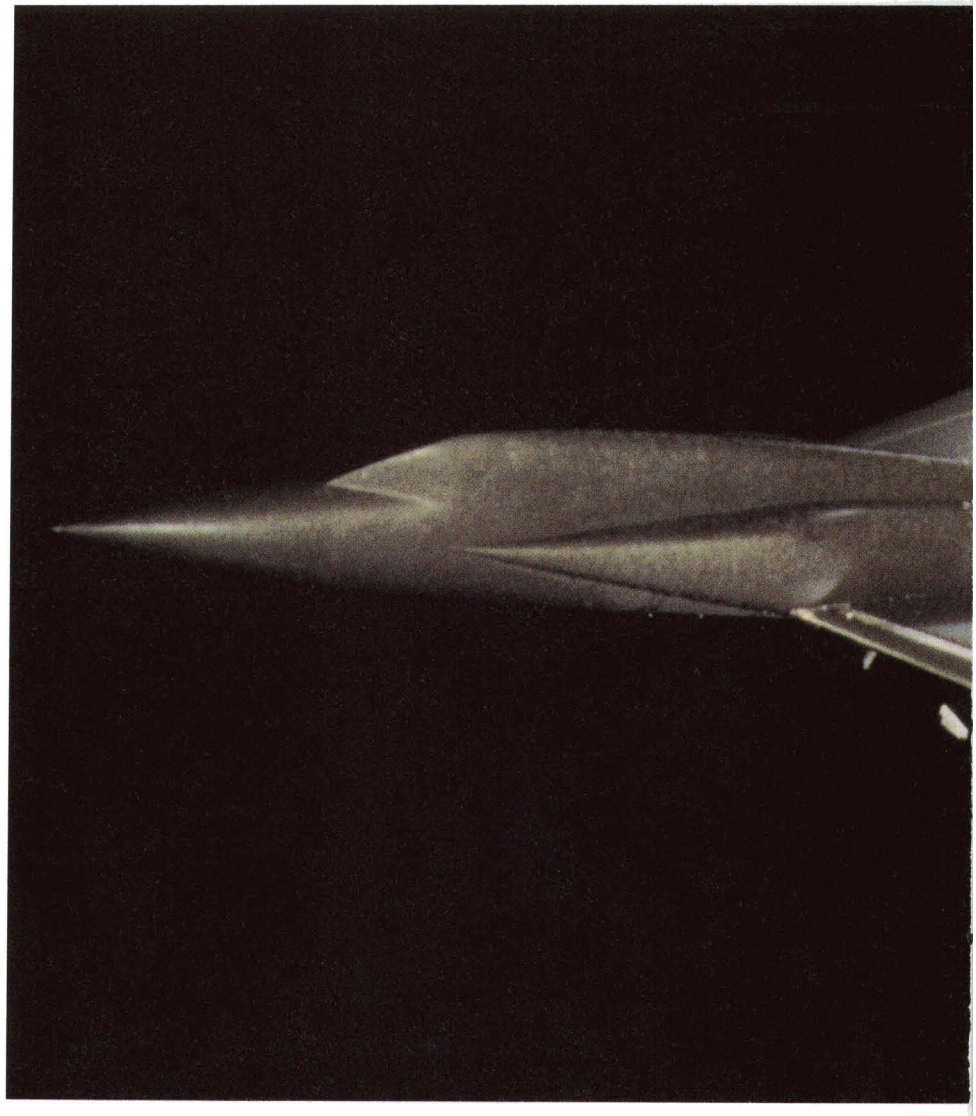


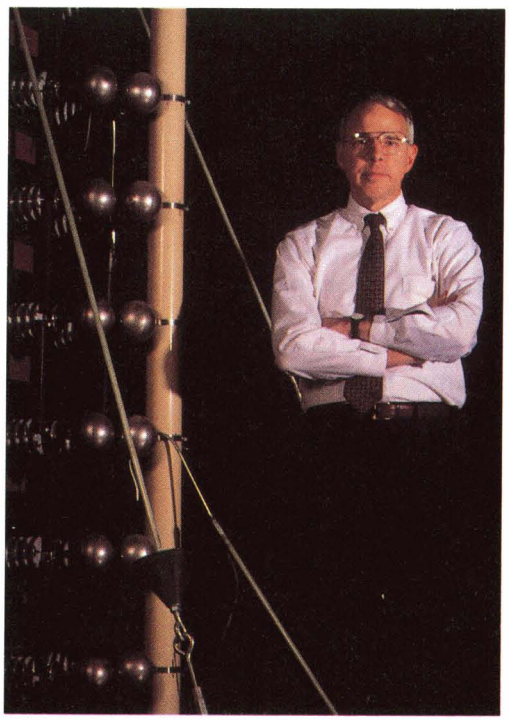
Lightning Protection



The project employed a specially-equipped research airplane, whose job it was to seek out thunderstorms

In the complex business of aerospace development, advancing technology on occasion heightens an existing problem — and therefore spawns further advancements of a corrective nature.

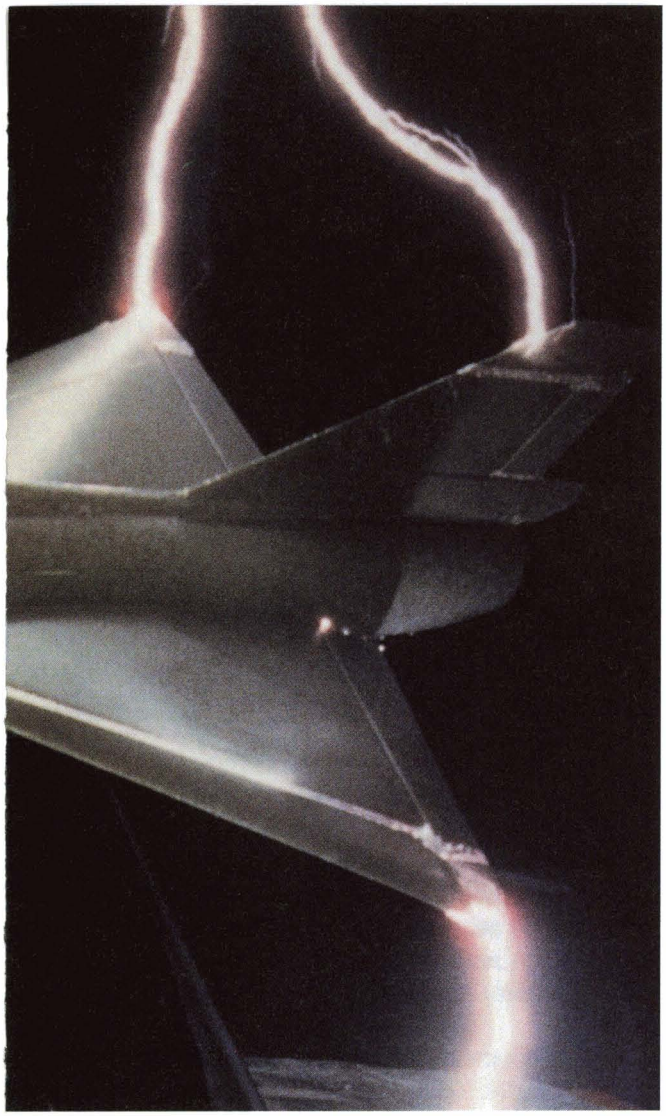
An example is the increasing use of composite materials, introduced to aircraft design to gain strength while reducing weight, and digital electronic systems that offer greater efficiency in flight and engine control. Both technologies tend to make aircraft more susceptible to lightning damage. But research by NASA, the Federal Aviation Administration (FAA) and other aviation groups has substantially improved understanding of how lightning affects aircraft and produced countermeasures that allow plane builders to incorporate these performance-enhancing technologies while improving safety.

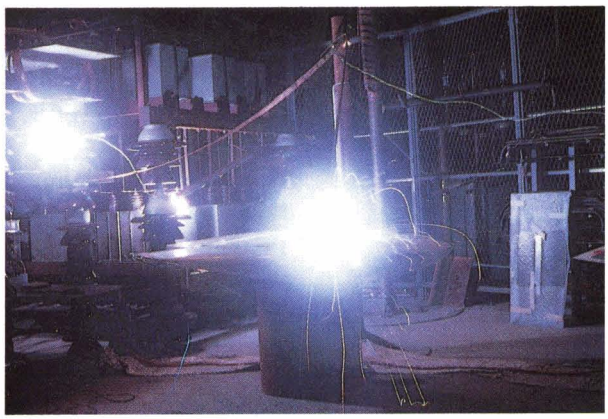


NASA played the leading role in lightning investigations with its seven-year (1980-86) Storm Hazards Research Program, undertaken at Congressional direction — by Langley Research Center — to determine the dangers of thunderstorms to commercial aviation. The project employed a specially-equipped, protected F-106B research airplane, whose job it was to seek out thunderstorms in the hope of getting struck by lightning. It was highly successful — more than 800 strikes were recorded. The program proved to be a giant step in advancing knowledge of lightning hazards and generating protective technology.

A key player in both the research program and the transfer of the technology to the aircraft industry is Lightning Technologies, Inc., Pittsfield, Massachusetts, a small engineering and testing firm engaged in design and verification of protection against lightning and other electrical hazards. Lightning Technologies is a spinoff company. It was founded in 1977 by president J. Anderson Plumer, a former employee of a NASA contractor — General Electric Company's High Voltage Laboratory — who had acquired extensive experience in lightning investigations. Shown **at left** beside a 1.5 million volt generator used for lightning simulations, Plumer is an example of the personnel-type of spinoff, wherein NASA technology is transferred to the private sector by the occupational shift of a scientist or engineer once engaged in NASA research activity.

In addition, much of the company's technological capability stemmed from its work as supporting contractor for the Storm Hazards Research Program, which involved assisting NASA in





planning the program, improving and verifying the lightning protection for the F-106B and, together with other organizations, analyzing the data. Both the company and its president worked extensively with the SAE Lightning Subcommittee, which formulates standards for aircraft lightning protection. The experience and technology thus gained has made the company a leader in lightning protection for aerospace systems.

Among the findings of the Storm Hazards Research Program, Langley researchers learned that multiple-burst lightning strikes inject a large number of randomly occurring electric currents into the airplane, producing rapidly changing magnetic fields that can induce erroneous responses, faulty commands or other upsets in sophisticated electronic systems.

This led the FAA — and airworthiness certifying authorities in other countries — to require, beginning in 1987, that aircraft electronic systems which perform flight-critical functions be protected from damage or upset due to the effects of the multiple-burst lightning environment.

The NASA research produced another important finding: that lightning strikes may hit almost any spot on an airplane surface, not just — as earlier believed — the plane's extremities, such as wings, propeller tips and certain other areas. That finding is of great importance to designers employing composite materials, which are less conductive, hence more vulnerable to lightning damage than the aluminum alloys they replace.

Lightning Technologies uses its NASA-acquired experience and technology to develop protective measures for both electronic systems and composite structures, including better electrical bonding and shielding methods for interconnecting wiring and methods of increasing system immunity through improved computer software and application of surge-suppression devices. The company also provides protection design and verification testing services for complete aircraft systems or their individual components; it numbers most major aircraft and component manufacturers among its worldwide clients.

The accompanying photos illustrate some of Lightning Technologies work: **the center photo** shows a simulated lightning strike on a model of an F-106 similar to the one used in the NASA research program; **above right**, a full-size aircraft component undergoes a high-voltage lightning test; **at right**, a company technician prepares a model of an airplane fuselage for computer analysis.

Multiple-burst lightning strikes inject a large number of randomly occurring electric currents into the airplane